uncles 2–5 cm. long, 1–1.5 mm. in diameter, tapering above, green to bronze-red. Spike 2 to 3 (4) cm. long, dense, ultimately of 4 to 6 distant nodes with 2 or more flowers at each; basal internodes 5–12 mm. long, the upper shorter. Sepaloid connectives 1–1.5 mm. high, 2 mm. wide. Pollen grains spherical to elliptical in outline. Fruits olive-green to fulvous, 4 mm. long, 3 to 4 mm. broad, somewhat compressed but the sides convex; stigma somewhat capitate but oblique, on a short stout style in fruit; beak about 1 mm. long, slightly curved. No winter buds observed although some of the ultimate branches are abbreviated and fleshy and may function as such.

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THE PLACE OF WILLIS LINN JEPSON IN CALIFORNIA BOTANY

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For three-score years Willis Linn Jepson, 1867–1946, was actively connected with the Department of Botany of the University of California as student, professor, and professor emeritus. Throughout this long period he was thoroughly devoted to the study of the flora of his native state and to furthering its interpretation and appreciation. To this end he founded the California Botanical Society in 1913, which he served as president, with the exception of three years, until 1929. In 1916 he launched the organ of the Society, Madroño, which he edited continuously through 1934. Much earlier, with the aid of E. L. Greene, he had founded and edited the journal Erythea.

The botanical writings of Jepson are both extensive and profound, and they have exerted a lasting influence upon our knowledge of the botany of California. The present account attempts to evaluate Jepson's lifework, as made known by these contributions, on the historical background.[1] A bibliography of authors who have named flowering plants occurring in the wild in California now includes well over 900 names! Where does Jepson stand among these?

Three stages can be recognized in the study of the California flora: (1) its study by Europeans; (2) by Americans along the eastern seaboard; and (3) by Californians. The first stage dates back to the late eighteenth century, when European explorers began to collect the objects of natural history that they found on these shores. By the early nineteenth century people in England had become greatly interested in horticulture, and expeditions were sent out to the four

[1] For sketches of Jepson, the man, giving more details of his active life, refer to (1)Herbert L. Mason in Madroño 9: 61–64, 1947; (2) Lincoln Constance in Science 105: 614, 1947; (3 & 4) Emanuel Fritz in California Forester 14: 6–8, 1947, and in Jour. Calif. Hort. Soc. 9: 23–26, 1948; (5) Marion R. Parsons in Sierra Club Bull. 32: 104–107, 1947; and (6) Joseph A. Ewan in Jour. Wash. Acad. Sci. 37: 414–416, 1947.

corners of the earth in search of plants to enrich British gardens. Bent on this purpose and showing amazing activity, David Douglas alone, Scotch collector for the Horticultural Society of London, now the Royal Horticultural Society, in his single season in California provided the material from which some 300 species were to be described.

The second stage, led by Thomas Nuttall, began around 1830, when the botanical exploration of the West by American botanists was under way. Soon John Torrey and Asa Gray were vying with the British botanists, W. J. Hooker and George Bentham, in the volume of West American species that they were bringing to light. During much of the latter half of the century, collectors by the dozen were sending West American plants to Dr. Gray, the highest authority of the period on the flora of this region. As a culmination of this stage there appeared the monumental two volume Botany of California by W. H. Brewer and Sereno Watson, with a large section contributed by Gray (1876, 1880). This invaluable work, based principally on the large accumulations of western material that had gravitated to Harvard and also the collections of Brewer and others made in connection with the Geological Survey of California, has been the starting point for all subsequent floras that have been produced in the state.

Gradually, as the third stage in the elucidation of the California flora, the West developed its own botanical authors. The first to publish a number of native species new to science was Albert Kellogg, a San Francisco physician. His contributions appeared particularly from the 1850's to the 1870's in the Proceedings of the California Academy of Sciences, the institution of which he was a founder.

By 1880 the botanical activities of the Reverend Dr. E. L. Greene had begun. His contributions through the years were very large, but were so rarely of a monographic nature that the proportion of his specific proposals that were to be widely accepted is not to be compared with that of Gray, Watson, or Jepson. Yet, as a pioneer worker in a region outstanding for the richness of its flora, and having a keen eye for small variations, which he named, it was inevitable that Greene's name should be associated with a goodly percentage of our California species. He contributed two local floras of value: Manual of the Botany of the Region of San Francisco Bay, 1894, and Flora Franciscana, 1891–97.

The first of the major botanical works produced by Jepson, who was a student of Greene, was A Flora of Western Middle California, 1901, second edition, 1911. He usually had several manuscripts in preparation simultaneously. His work on one yielded information or suggested ideas applicable to another. About the time he finished work on this book he projected The Silva of California (1910), The Trees of California (1909, second edition, 1923), and A Flora of California, which from the first he looked upon as his greatest life's work. Jepson himself says[2] the Flora was planned in 1894. The first two parts ap-

[2] Flora of California 2: 7, 1936.

peared in 1909, the twelfth part in 1943. Work was actively progressing on the thirteenth part until illness interrupted, and the author's death a year later in 1946 found the Flora about three-fourths completed and published. Volume I starts on page 33, the first 32 pages being reserved for an introduction that was to have appeared upon the completion of the whole work. Its seven parts, otherwise complete, are not indexed. Volume II is complete, but the index is to families and genera only. The two completed parts of volume III are not indexed.

Jepson was thoroughly aware of these deficiencies and was almost reticent in advertising the parts of the Flora that were available. As in the case of A Manual of the Flowering Plants of California, which was also issued in parts, from 1923 to 1925, he preferred to withhold advertising of the parts as they appeared individually, because for the general user the completed work would prove more useful, and it was desirable not to deplete the stock of any one part before the entire volume could be bound. Because of these shortcomings, Jepson's Flora is definitely less convenient than his Manual, particularly for use in the field, and therefore has not received the general recognition and use that it deserves, but the quality of workmanship in the later parts is unsurpassed in any similar American work.

Jepson's major projects built progressively upon one another. As the Flora of Western Middle California built upon Brewer and Watson's Botany of California, Gray's Synoptical Flora of North America, and the works of Greene, appreciably advancing our knowledge of the plants of its area, so the Manual drew upon this work and the portions of A Flora of California then completed to become one of the finest botanical handbooks extant. Similarly, succeeding parts of the Flora mark a distinct advance over the Manual. As would be anticipated in a work that was to appear in parts over more than a third of a century, A Flora of California is uneven in treatment. The progressive improvement noted in volumes II and III as compared with volume I reflect not only the scientific growth of the author, but also the growth of botany in the West.

At a very early time Jepson had to decide whether to use the system of measurement based on the foot, inch, and line, used by the English botanists and the Harvard school, or to adopt the metric system coming into vogue on the Continent. He chose to follow the former, and, having committed his Flora to this system, was forced to continue, even though it was soon evident that the English system had been becoming obsolete from the turn of the century. By the time his Manual appeared in 1925, Jepson was originating the only major flora in America that did not follow the metric system.

This relatively minor fault, if fault it be, is nevertheless one of the few mechanical details to which exception can be taken in the works of one who put mechanical perfection very high indeed among the obligations of an author. Jepson's works are freer from typographical error than those of almost any other American botanist due to the fact that he

meticulously read proof himself and left no mechanical detail to the discretion of his printer.

Jepson strove for a uniform treatment and avoided introducing chromosome numbers, genetical data, and other experimental results that, by the time the later parts of the Flora were appearing, were becoming a determinative influence in taxonomy. It is well that he stayed on wholly familiar ground, continuing to rely on those tools which he handled as an adept—accurate descriptive morphology and analysis and a keen perception for the place of the plant in its natural environment. The story that he wrote he was perhaps better prepared to write than any other person.

The inclusion in later parts of the Flora of excerpts from Jepson's very extensive field notebooks on the ecology, physiology, and morphology of many species is of great value. The reader finds much interesting and original information under such a variety of titles as: geographical note, field note, leaf variation, taxonomic note, note on relationship, biological note, etc. Jepson was not only an astute observer; he was a facile writer whose written word was forceful, clear, and often of great beauty.

His appreciation of the historical precedent and the classical style stemmed not only from his teacher, E. L. Greene, who valued these especially highly, but also from his study of the works of the greatest systematists and from a reading of the classics. He urged upon his students the desirability of becoming familiar with great works on travel and biography as a proper foundation for work in taxonomy.

Students of west coast botany are fortunate that the principal task of organizing their flora has been done by one with the sound botanical judgment of Jepson. This he did not learn from Greene, nor from other contemporaries in California, but from a devoted study of the artistry of the great British systematists of the nineteenth century. That he profited much from this study is evident from the quality of his work, which has made an impress on the writings of others.

Jepson, with an intuitive grasp of what are good species and genera, organized the scattered knowledge of the complex California flora in a remarkable way. He introduced the Englerian system of phylogeny to California, but here and there made his own appraisals of the proper positions for the families. His species concept was grounded on so sound a morphological basis that, on the whole, it has been widely accepted, and the present-day methods of the experimental gardens and the cytological laboratories usually substantiate rather than displace Jepson's judgments. Relatively few of his contemporary authors have found their work so generally acceptable.

In gauging Jepson's place in California botany, the writer was prompted by curiosity to tabulate the number of species in the state named by each author, using unchanged the data as given in Jepson's Manual, our last complete list. Despite the shortcomings of the Manual data, such as the incomplete synonymy, the resulting list is of some interest. Here are the top 15 names, including all those who

have named 50 or more species in the Manual, together with the number of names contributed by each.

1. Asa Gray	717	9. Willis Linn Jepson	154
2. Carolus Linnaeus	431	10. David Douglas	86
3. Edward Lee Greene	365	11. George Engelmann	74
4. Sereno Watson	283	12. A. P. de Candolle	68
5. Thomas Nuttall	266	13. Frederick T. Pursh	64
6. John Torrey	245	14. George A. W. Arnott	58
7. George Bentham	188	15. Joseph Nelson Rose	51
8. William J. Hooker	160		

The only Californians among the first 15 are Greene and Jepson, and these are grouped among the classical students of the California flora. Albert Kellogg, however, with 48 species, is in sixteenth place. Other Californians among the first 50 are A. A. Heller, T. S. Brandegee, Alice Eastwood, H. M. Hall, Katherine Brandegee, and S. B. Parish, in that order.

Jepson worked in that transitional period between the time of Greene, when new species were yet to be found on almost every mountain range and valley floor, and the present, when even monographic researches uncover relatively few acceptable new species. Considering the conservative stand that he took on the matter of describing new species, it is interesting how high in the list his name is found. Jepson preferred to evaluate critically his own proposals before offering them to the world. This is one reason that his work has attained a lasting character.

The influence of Jepson does not rest wholly upon his writings. The relatively small number of graduate students that he found time to encourage came impressionably under the influence of his strong character. Their training would doubtless be considered unorthodox and irregular, but certain fundamentals about meticulous detail in observation of the plant, whether in the field or in the laboratory, and a broad appreciation for the contributions from related fields were drilled into the memory. His graduate student seminars were often his sole contact with the student. These were broadening and often dramatic experiences that challenged the imagination to reach out; they served to turn the student's attention from the local flora, with which Jepson's life would seem to be engrossed, to the far corners of the earth and to many fields untouched by Jepson's writings. The beneficial influence of this training is apparent from the sound taxonomic practices of those trained by him and, in turn, of their students.

Jepson succeeded in imparting to his public, which consisted in good part of laymen as well as of students, his deep feeling for nature. He looked upon the plant not only with the discriminating eye of the master systematist, but also with the enthusiasm and reverence of the naturalist and woodsman. Perhaps most beautifully expressed was his love for trees, so obvious in the Silva. One's love of nature is apt

to govern in direct proportion one's concern for conservation, and so it was that Jepson was a founder and prominent spokesman for the Save-the-Redwoods League and a staunch advocate of forest conservation measures and such other endeavors as the Point Lobos Reserve. All in all, it has been through many channels that the works of Jepson the botanist have become known, not only to his California audience, but to the world at large.

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REVIEWS

The Evolution of Gossypium and the Differentiation of the Cultivated Cottons. By J. B. Hutchinson, R. A. Silow and S. G. Stephens. Oxford University Press. 160 pp. 10 figs. 1947. 15s.

The genus *Gossypium* is of outstanding interest not merely because of the economic importance of cotton, but in respect to the taxonomy, genetic relationships, morphology, and physiology of the plants. To botanists of the Pacific Coast the interest is enhanced by the fact that of approximately 16 truly wild species of this genus, 4 are indigenous to the shores and islands of the Gulf of California.

The scope of the admirable little book under review is indicated by its title and by the titles of the parts: Part 1, The classification of the Genus Gossypium, by Hutchinson; Part 2, The Evolution of the Species of Gossypium, by Hutchinson and Stephens; Part 3, The Differentiation of the True Cottons, by Hutchinson and Silow; and Part 4, The Significance of Gossypium in Evolutionary Studies, by Hutchinson and Stephens. It would be hard to find authors more competent to deal with these matters, all three of them having carried on original research that has advanced, substantially, our knowledge of the subject.

In treating "The Relationships of the Genus," the authors follow Edlin in transferring the tribe Hibisceae, to which *Gossypium* belongs, from the Malvaceae to the Bombacaceae, on the ground that the fruits are capsular (loculicidally dehiscent), not septicidally dehiscent into schizocarps, as in the other tribes of Malvaceae. But this distinction is not absolute because normally in *Bastardia* and occasionally in *Sphaeralcea* and other genera which no one would think of removing from the Malvaceae, the septicidal dehiscence is very imperfect. There seems to be no sharp line of demarkation between the two families and perhaps we should return to the classification of Bentham and Hooker, and regard the Bombacaceae as merely a tribe or subfamily of the Malvaceae.

In the classification of the species, the authors follow, in the main, that which was first outlined by Zaitzev, and later amplified by S. C. Harland, on the basis of cytogenetic studies. Three